RECOVERY PLAN FOR THREE ENDANGERED SPECIES Endemic to Antioch Dunes, California

76pp.

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REVISED

RECOVERY PLAN FOR THREE ENDANGERED SPECIES ENDEMIC TO ANTIOCH DUNES, CALIFORNIA

Lange's Metalmark Butterfly, Contra Costa Wallflower, and Antioch Dunes Evening-Primrose

Initially Approved March 21, 1980

Prepared by U.S. Fish and Wildlife Service

Region 1

Portland, Oregon

Revision Approved: Bill Meyer

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Acting Regional Director, U.S. Fish and Wildlife Service

4/25/84

Date

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THIS IS THE COMPLETED REVISED RECOVERY PLAN FOR THREE ENDANGERED SPECIES* ENDEMIC TO ANTIOCH DUNES, CALIFORNIA AND THEIR TRANSPLANTED POPULATIONS. IT HAS BEEN APPROVED BY THE U.S. FISH AND WILDLIFE SERVICE. IT DOES NOT NECESSARILY REPRESENT OFFICIAL POSTIONS OR APPROVALS OF COOPERATING AGENCIES AND IT DOES NOT NECESSARILY REPRESENT THE VIEWS OF ALL THOSE WHO PLAYED KEY ROLES IN PREPARING THIS PLAN. THIS PLAN IS SUBJECT TO MODIFICATION AS DICTATED BY NEW FINDINGS AND CHANGES IN THE STATUS OF SPECIES AND COMPLETION OF TASKS DESCRIBED IN THE PLAN. GOALS AND OBJECTIVES WILL BE ATTAINED AND FUNDS EXPENDED CONTINGENT UPON APPROPRIATIONS, PRIORITIES, AND OTHER BUDGETARY CONSTRAINTS.

ACKNOWLEDGMENTS SHOULD READ AS FOLLOWS:

REVISED RECOVERY PLAN FOR THREE ENDANGERED SPECIES ENDEMIC TO ANTIOCH DUNES, CALIFORNIA. APPROVED: MARCH 21, 1980 AND REVISED: April 25, 1984.
U.S. FISH AND WILDLIFE SERVICE, PORTLAND, OREGON.

*Lange's Metalmark Butterfly (Apodemia mormo langei Comstock)
*Contra Costa Wallflower [Erysimum capitatum (Dougl.) Greene var. angustatum (Greene) G Rossb.
*Antioch Dunes Evening-Primrose [Oenothera deltoides Torr. & Frem. subsp. howellii (Munz) Klein]

ADDITIONAL COPIES OF THIS PLAN MAY BE OBTAINED FROM

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D-052682

RECOVERY PLAN FOR THREE ENDANGERED SPECIES ENDEMIC TO ANTIOCH DUNES, CALIFORNIA

PART I. INTRODUCTION

Three Federally listed endangered species endemic to the Antioch Dunes in California are the subject of this plan. These are the Lange's metalmark butterfly (*Apodemia mormo langei* Comstock), Antioch Dunes evening-primrose [*Oenothera deltoides* Torr. & Frem. subsp. *howellii* (Munz) Klein] and Contra Costa wallflower [*Erysimum capitatum* (Dougl.) Greene var. *angustatum* (Greene) & G. Rossb.]. Loss and modification of habitat over the last 130 years have caused these species to decline to a point of severe endangerment. Various factors (e.g., exotic vegetation, industrial development, and other human activities) continue to threaten the dunes.

The Antioch Dunes are adjacent to the San Joaquin River east of the City of Antioch in Contra Costa County,

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1/ Note: Antioch Dunes evening-primrose and Contra Costa wallflower are listed as endangered under State law by the California Department of Fish and Game.

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California (Figure 1). They are located about 40 miles northeast of San Francisco near the confluence of the Sacramento and San Joaquin Rivers. The dunes are part of an aeolian sheet of sand that underlies a large portion of eastern Contra Costa County. According to Brian Atwater (pers. comm. 1981) of the U.S. Geological Survey, the present Antioch Dunes were created:

"[d]uring [the] waxing and/or waning [of] glaciation, [where] glacially eroded sediment from the Sierra Nevada and southern Cascade Range choke[d] arterial streams draining the Central Valley, creating sandy floodplains at the sites of western Delta and Suisun Bay. The latter two areas were subaerially exposed because of low glacial-age sea levels. Summertime winds blowing into the Central Valley from the west ...[lifted]... sand from the floodplains and deposit[ed] it as dunes to the east and southeast."

Beneath these 15,000 year-old surficial dunes are sands thought to be about 40,000 to 70,000 years in age. Thus, a dune system at Antioch may have existed as far back as the Xerothermic, a period of higher temperatures and lower rainfall (Howard and Arnold 1980). Perhaps these isolated

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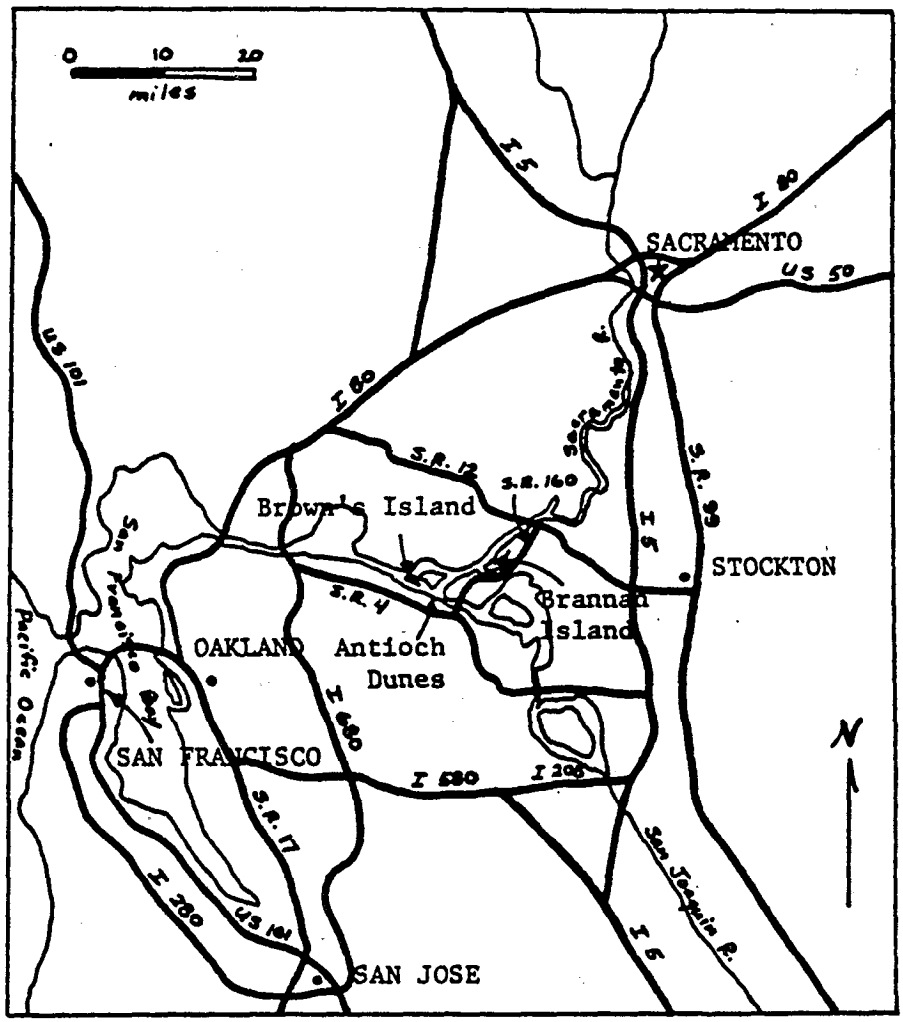

FIGURE 1. General location of Antioch Dunes.

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sand dunes in the Central Valley, like Antioch, provided a relictual habitat for biota that may have migrated northward from what is now the Mojave Desert during the Xerothermic (Howard and Arnold, 1980). This may account for the great number of endemics found at Antioch.

Scientists of many disciplines are interested in the Antioch Dunes and its associated unique biota. Their concern helped the U.S. Fish and Wildlife Service acquire approximately 60 acres of this rapidly vanishing dune habitat on March 6, 1980. The acquired properties have been added as a "satellite" to the San Francisco Bay National Wildlife Refuge Complex. The Service is continuing to negotiate cooperative agreements with adjacent private landowners to protect about 20 additional acres of valuable habitat. This recovery plan will address the steps necessary to alleviate immediate threats to these endangered species and their habitats. The combined efforts of various agencies are expected to increase the populations of these species to reduce the probability of their stochastic extinction. This plan is based on currently available information and will be up-dated as more information becomes available.

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Protection of the Antioch Dunes is necessary to conserve the unique assemblage of biota of the dunes. Antioch, presumably the dunes, is the type locality for at least 27 insect taxa. Thirteen of these taxa are endemic to the dunes while six are known only from other endangered habitats. J.A. Powell is said to have information suggesting eight are endemic and nine are known only from other endangered habitats. Two species which had wider ranges in pre-agricultural times may now only exist at Antioch Dunes. Five insect species are recorded as being extinct (Appendix 1). The herpetofauna is also notable in that many taxa with desert affinities inhabit the dunes (see discussion, Howard and Arnold 1980).

Padre Font, chronicler of the 1776 Anza expedition, provided the earliest description of the Antioch Dunes. The first known good description of the Antioch Dunes, written in 1895 by botanist J. Burtt-Davy, referred to a natural levee of sand some 150 to 200 feet high along several miles of the south bank of the river (Howard and Arnold 1980). Aside from grazing, exploitation of the dunes had already begun in earnest by 1865, with the establishment of a pottery works. Later, two brickyards

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were in operation. A 1908 U.S. Geological Survey topographic map shows sand deposits stretching for about two miles along the river, averaging about a sixth of a mile in width and reaching heights of 100 feet or more. The total dune area amounted to roughly 190 acres although larger figures have appeared, evidently erroneously, in the literature (Howard and Arnold 1980).

Today the dunes cover an area of roughly 70 acres, of which only an extremely small percentage of the area is in the configuration of a dune. Heavy industrialization, sand mining, agricultural conversion, fuel-break maintenance for fire control, powerline right-of-ways, wildfire, off-road vehicles (ORV), and other human activities have caused and to some degree continue to cause deterioration and loss of habitat. While the dunes themselves were never converted to agricultural, level areas of the same soil type were so managed. Moreover, weedy exotic plants have invaded the dunes since the arrival of the Franciscan missionaries, thus reducing the potential for reestablishment of native species.

In 1976 a portion of the dunes was proposed for development as an 84-acre waterfront park (City of Antioch,

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1976). This presented an additional threat to the flora and fauna of Antioch Dunes. Park plans included a boat docking facility, fishing pier, swimming lagoon, campground, picnic area, and natural science center. The recreational park facilities, in part, would have resulted in human activities detrimental to survival of the native biota. The State of California withdrew the project in March 1979, even though the City of Antioch changed the zoning to permit the park. This was done primarily because a bond election failed to raise the necessary matching funds from the city.

The acquisition of the Sardis and Stamm-Starr properties by the U.S. Fish and Wildlife Service will prevent their further industrial development and will facilitate habitat improvement and protection activities. While the major threat has been curtailed, other more subtle threats remain to be controlled or eliminated. These threats and other more obvious threats will be discussed later.

The completed management plan for the area, including any properties for which MOU agreements are signed, will propose corrective measures for these and other known threats

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or administrative difficulties. The management plan will be revised as determined necessary to accomplish the Service's long-range intent and purpose for the area - protection and maintenance of essential habitat for the two species of plants and one species of insect.

Species Information

LANGE'S METALMARK BUTTERFLY (*Apodemia mormo langei*) was described in 1938 as a result of intensive entomological studies on the Antioch Dunes. These studies were initiated in 1931 and continued through the decade. Additional studies were conducted in the years following World War II. Much of the data available on the biology of this species are contained in reports by Powell and Arnold (1977) and Arnold (1978). Arnold's doctoral dissertation, completed in 1980, is the major source of information on the butterfly employed in this recovery plan.

Status and Distribution

Lange's metalmark butterfly was listed as an endangered species by the U.S. Fish and Wildlife Service (FWS) on

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June 1, 1976 (41 FR 22141-22044) and critical habitat was proposed on February 8, 1977 (42 FR 7973). The present range of the subspecies has been reduced to only approximately 15 acres of suitable habitat.

Arnold (1980) over a 9-day sampling period in 1977 estimated a population of 400 adult butterflies at the Little Corral site (includes Sardis unit of the refuge, both PG&E parcels, and the Domtar and McCullough properties). Total population size would be higher because the flight season is approximately one month long (Arnold, pers. comm., 1982). Densities reported by Arnold (1980) in 1977 were 28.7 males/acre and 41.8 females/acre. It was previously thought that adult females lived nine days or less while males presumably were even shorter lived (USFWS 1978)*. However, both sexes live approximately one week (Arnold 1980).

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*The information cited within this 1978 FWS report is predominately the work of Richard Arnold and Jerry Powell, lepidopterists and experts on the Lange's metalmark butterfly.

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Life History and Population Dynamics

Lange's metalmark butterfly is univoltine (produces one brood in a season). Adults emerge in early August and can be observed until mid- or late-September. Numbers peak two or three weeks after the earliest date of eclosion, the emergence of the butterfly from the pupal case. The peak in male emergence is generally earlier than that of females (Arnold 1980).

Egg laying occurs throughout the adult flight period. The gray eggs are laid on the lower half of the larval food plant, a subspecies of naked buckwheat, Eriogonum nudum var. auriculatum (Reveal in Munz 1968)[= E. latifolium subsp. auriculatum (Munz 1959)]. Eggs are placed on the stem axils on the less pubescent surface of the withered foliage. They often are deposited in clusters of two or four but may infrequently be laid singly. The eggs remain attached and dormant until the rainy season, at which time the larvae hatch and crawl to the base of the plant where they overwinter and feed if new foliage is available (Arnold 1980).

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The larvae are nocturnal feeders and they begin to feed on new plant growth in late fall or early winter. Pupation occurs in mid-summer in the litter at the base of the buckwheat (Arnold 1980).

Adults of both sexes are perchers and are capable of long movements between observed perches. The majority of males move locally (less than 30 meters) while females may travel up to 400 meters (USFWS 1978). Both sexes prefer buckwheat flowers as perches and as a nectar source. Female butterflies visit a greater variety of secondary nectar sources than do males, which tend to perch or aggregate more than females. The greater vagility of the females is thought to result from their search for suitable egg-laying sites and secondary nectar sources. Usually neither sex, however, moves very far from the buckwheat plants. Nevertheless, females tend to move more frequently between clumps while the less-mobile males remain within a single clump of buckwheat for various periods of time (Arnold, 1980).

Prior to fuelbreak maintenance activities on the Pacific Gas and Electric (PG&E) west tower site in 1979 (Figure

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2), Johnson (1978) reported an Eriogonum population of 1,661 mature (flowering) plants, 1,352 rosette plants, 206 seedlings, and 20 dead plants (the accuracy of Johnson's work has been questioned by some). Because recruitment (number of growing seedlings) exceeded deaths, the buckwheat population appeared at that time to be self-maintaining. The highest density of buckwheat occurred where the cover consisted mainly of filaree (Erodium spp.), an annual believed to be an introduced plant. Conversely, stands of an exotic grass, "ripgut" (Bromus diandrus), included few buckwheat plants. Because herbaceous cover dominated by filaree is typically more open than that covered with ripgut, establishment of buckwheat seedlings seems to require more open ground. Nonetheless, mature plants appear able to compete with ripgut. The modification of the microclimate by the ripgut at the base of these buckwheat plants evidently reduces the survivability of the larvae (Arnold, pers. comm. 1982).

Arnold (pers. comm. 1979) reported that approximately 500 to 600 Eriogonum plants at the west tower site were destroyed by fuelbreak discing. A PG&E contractor was reportedly operating without the permission of the company. About 30 to 40 percent of the buckwheat plants

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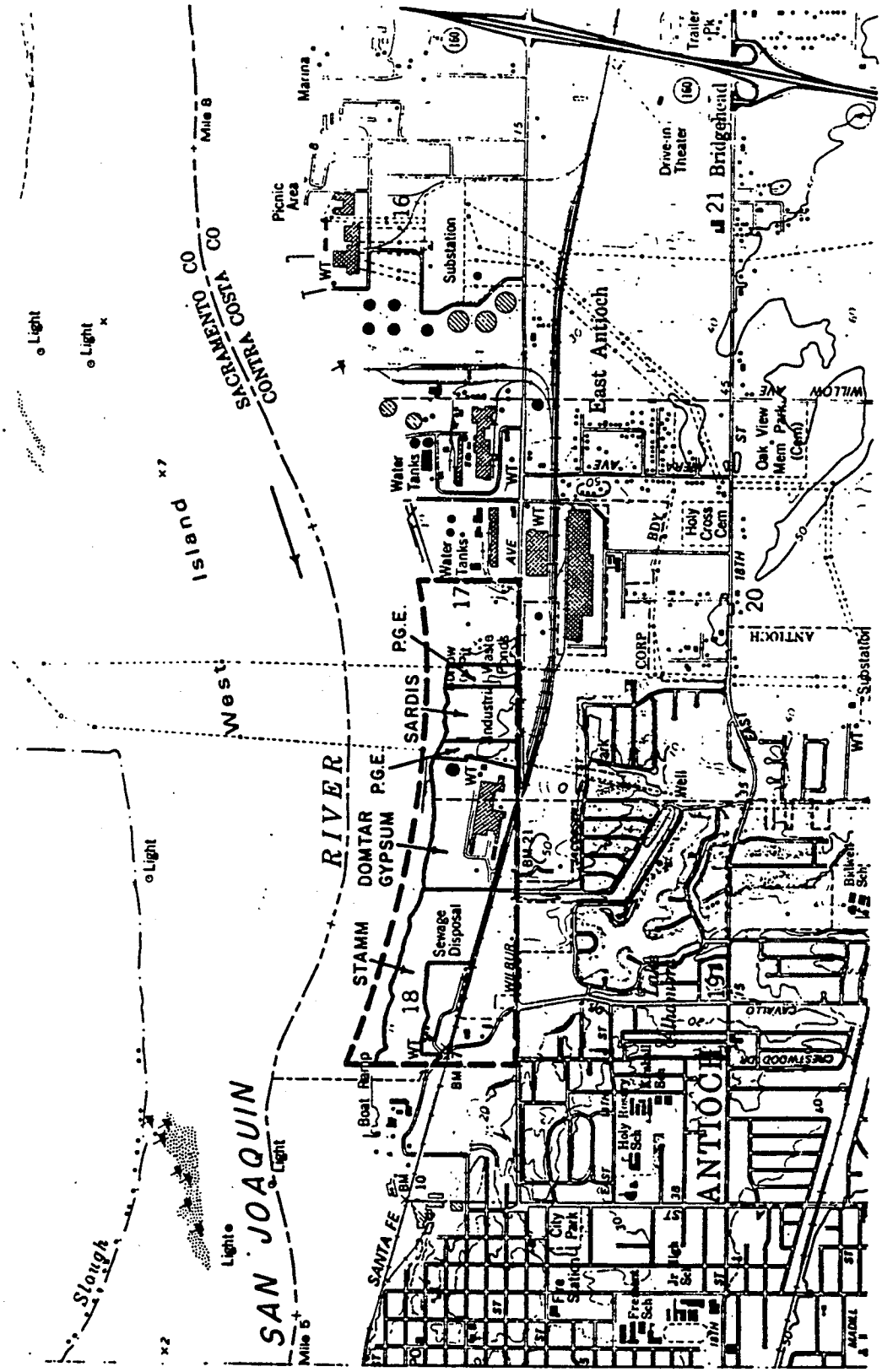

Figure **2a.** Proposed Critical Habitat for Lange's metalmark butterfly and designated Critical Habitat for Antioch Dunes evening primrose and Contra Costa wallflower; Contra Costa County, T.2N., R.2E., SW 1/4 Sec. 17, E 2/3 of S 1/3 Sec. 18. (Federal Register, Vol. 42, NO. 26, February 8, 1977.)
(Antioch North, 1:24,000)

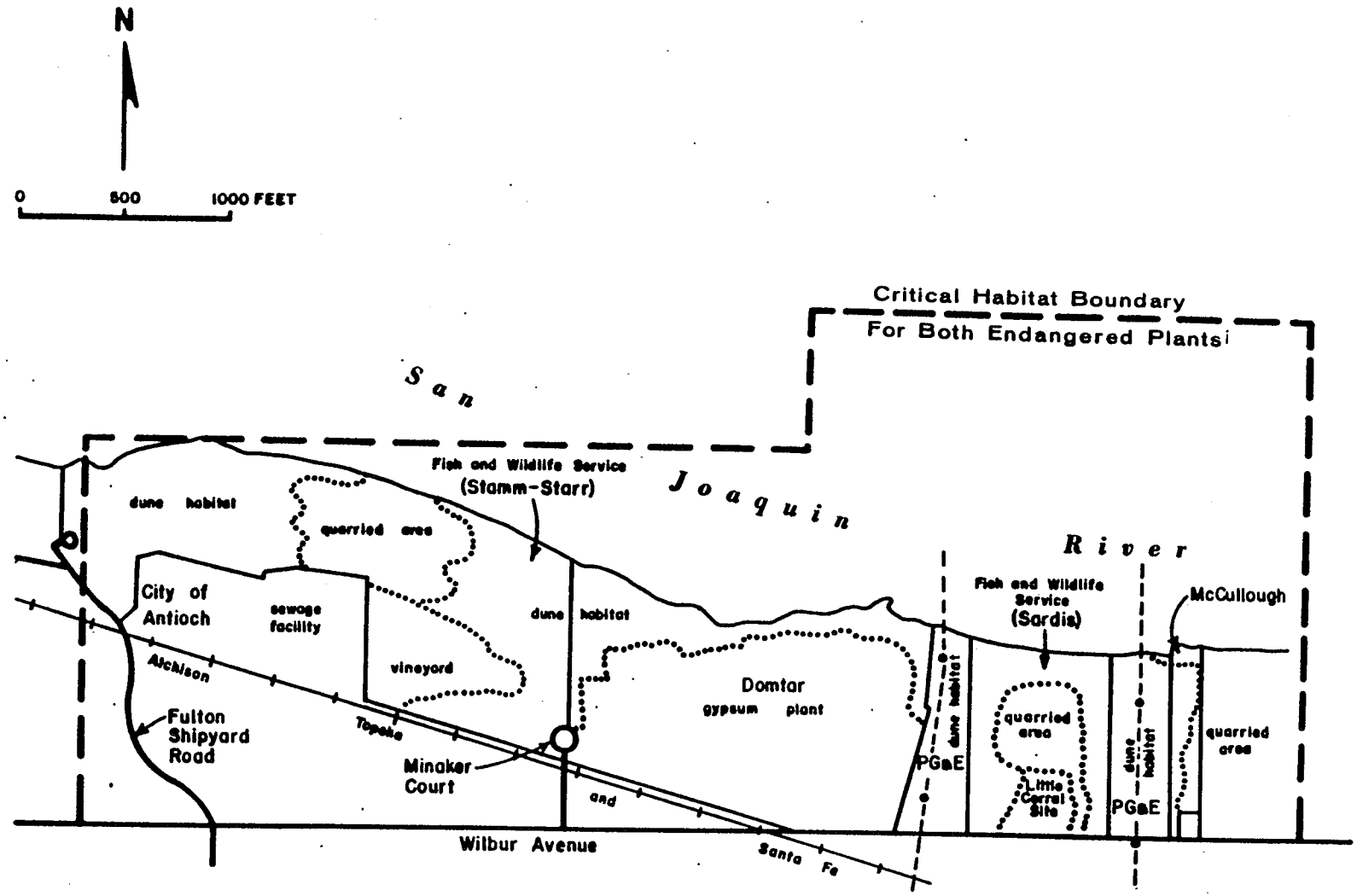

Figure 2b. Property lines and ownerships at Antioch Dunes.

on the former Stamm-Starr property have been destroyed by sand quarrying and ORV activity since May 1979 (Arnold, pers. comm. 1982). Seedling re-establishment, currently vigorous at the less weedy Stamm-Starr site, is being supplemented on the west tower site by transplanted cultivated seedlings, mostly through private efforts.

Threats

The primary factors limiting the size of the butterfly populations are the availability of nectar sources for adults, adequate host plants for egg-laying, and sufficient food for larvae. Losses of these habitat components via human activity in the area have severely reduced population levels. (The buckwheat also serves as a primary nectar and pollen source for many of the sand-nesting bees and wasps present on the dunes.) Invasion by exotic plant species evidently has reduced the potential for reestablishment of native plants like the buckwheat. Unless the exotic plants are eliminated or reduced to some degree, they will continue to limit the reestablishment of native vegetation. Moreover, additional losses of buckwheat caused by discing for fuelbreaks probably will result in further reductions in the numbers of butterflies. Although most disced and mined areas may eventually sup-

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port Eriogonum, these areas recover slowly. Possibly other natural mortality factors exist today that are not known or understood.

A devastating wildfire in 1976 near the PG&E east tower destroyed most of the butterfly larvae present and much of the buckwheat stand. Today the Eriogonum has largely regained its former numbers, although the size and shrubbiness of the plants apparently is still not yet sufficient to support a self-sustaining colony (Arnold, pers. comm. 1982). Butterflies have been observed at the site of the wildfire since 1977, but these appear to be immigrants (Arnold, pers. comm. 1982).

ANTIOCH DUNES EVENING-PRIMROSE (Oenothera deltoides subsp. howellii) is a member of the evening-primrose family (Onagraceae) and the subgenus Anogra. Although there is a strong consensus today on the taxonomic status of the plant (Warren Wagner and William Klein, pers. comm. 1982), this was not always the case. In 1925 Jepson described O. trichocalyx var. cognata, from Corral Hollow in Alameda County. Munz in 1931 placed a collection of Oenothera from the Antioch Dunes in Contra Costa County

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with O. deltoides var. cognata. This was a new varietal combination employing Jepson's earlier varietal epithet. Jepson (1936) later concurred that the material from Antioch was the same as that from Corral Hollow, but he did not accept Munz' specific epithet for the Antioch Dunes evening-primrose.

Alice Eastwood and John Thomas Howell collected the Oenothera from Antioch in 1936 and later Howell brought it to the attention of Munz. Munz concluded from observations of cultivated and field-collected specimens that the Antioch Dunes evening-primrose was indeed a distinct entity. He named the plant O. deltoides var. howellii in honor of Howell. Munz employed the pinnatifid leaves, long-pointed buds, and perennial habit to distinguish this evening-primrose from O. deltoides var. congata.
Later Klein (1962), after a biosystematic investigation of several entities of the subgenus Anogra, accorded the Antioch Dunes evening-primrose along with other taxa subspecific rank. Ultimately Munz (1965), in his monograph of the Onagraceae in the North American Flora Series, concurred with Klein's subspecific treatment of the plant. Furthermore, breeding studies by Klein (1970) substantiated that the Antioch Dunes evening-primrose has

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a strong affinity for the O. deltoides complex. Consequently O. deltoides subsp. howellii remains the most appropriate scientific epithet at this time for the Antioch Dunes evening-primrose (Klein, pers. comm. 1982).

Status and Distribution

The Antioch Dunes evening-primrose was listed as an endangered species by the U.S. Fish and Wildlife Service on April 26, 1978 (43 FR 17909-17916), while critical habitat (Figure 2) was determined on August 31, 1978 (43 FR 39042-39044). While debatable whether it was historically more or less common within the Antioch Dunes, recent reports from Howard (pers. comm. 1984) indicate significant reductions in evening-primrose over the last few years. Johnson (1978) reported an Oenothera population of 872 flowering plants, 376 small plants with few or no flowers, 184 rosette plants, and 97 dead plants on a 27-acre portion of the dunes. She observed no small seedlings. Johnson, however, did not examine the Stamm-Starr site, which now has the largest stand. Arnold (pers. comm. 1982) noted that at the PG&E east tower site, the plant readily recolonizes disced areas.

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The historic range of Oenothera deltoides subsp. howellii is unknown and open to speculation. Presumabaly it was limited to the sandy soil type (Oakley or Delhi sand) found at the dunes and over a substantial portion of eastern Contra Costa County. Nevertheless, there is no evidence to show that the subspecies historically occupied any area other than the Antioch Dunes proper. Future research may help resolve this question, however, this seems doubtful in view of the poor historical accounts and specimen collections.

The only natural stands of evening-primrose exist on the dunes near Antioch. Nonetheless, the subspecies has been introduced into at least three different localities by Regional Parks Botanic Garden personnel since 1970. The inspiration for this action was James B. Roof, director emeritus of the botanic garden. In a 1969 article, Roof felt at the time that a possibile solution to the grave threat sand mining posed for the dunes "may lie along the same lines of dispersal to remote dunes areas." As a result, seed was sown by Walter Knight, former staff member of the Regional Parks Botanic Garden, on "low dunes" at Brannan Island State Recreational Area,

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Sacramento County (Knight, pers. comm. 1979; anonymous 1971). In addition, Roof introduced evening-primrose seed onto the dunes at Point Reyes National Seashore in Marin County (Anonymous 1971). These two localities were discussed by Roof in 1969 as suitable sites for introduction of evening-primrose seed. Although the experiment failed at Point Reyes, the Oenothera became naturalized at Brannan Island and thrives there today. Knight (pers. comm. 1979) also reported starting two small colonies in 1978 on Brown's Island in Contra Costa County. Although he believed the plant was doing well on the island, Howard reported (pers. comm. 1983) that the plants apparently were declining in 1982.

Life History, Population Dynamics, and Habitat Requirements

One of the characters employed to separate Oenothera deltoides subsp. howellii from O. d. subsp. cognata is its genuine perennial habit (Klein 1979), yet differing opinions exist as to the longevity of the Antioch Dunes evening-primrose. Munz in his descriptive article in 1949 stated that it was "apparently [a] short-lived perennial." He later referred to the plant as perennial, dropping

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"short-lived" as a modifier (Munz 1959 and 1965). Roof (1969), however, described the Oenothera as a biennial in cultivation. Seedlings after blooming their first spring, bloomed "profusely" the second year. Nonetheless, Roof noted that a few individuals flowered in later years, but these were "sickly and worthless as flowering specimens."

Klein stated the perennial condition of the Antioch Dunes evening-primrose was of adaptive significance. He postulated that the perennial habit was in response to "more mesic conditions." He further noted that the manner in which Oenothera deltoides subsp. howellii perennated was quite distinctive from other members of the subgenus Anogra. Oenothera deltoides subsp. howellii "has extensive fleshy roots which penetrate to considerable depths into the sand and buds located near the crown" in contrast to the creeping horizontal stems of O. avita subsp. avita and O. a. subsp. eurekensis (Klein 1970).

Klein (pers. comm. 1982) claims that given proper care O. d. subsp. howellii will persist "indefinitely in the garden." This supports observations made in 1979 by

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Robert Justice (pers. comm. 1980), Ranger at Brannan Island State Recreational Area. He noted that some individuals on one small dune at Brannan Island have persisted for several years.

According to Harper (1977), biennials are a function of the horticulturalist and are not "clearly defined in nature." Harper continues, "[t]he critical feature of the so-called biennial habitat is that the plants usually die after seed set." Oenothera deltoides subsp. howellii does not meet this qualification. Many plants believed to be biennial, like the evening-primrose, are in reality short-lived perennials that reach their reproductive peak their second year. Thus, Roof's (1969) and Klein's (1970) work would seem to agree with Munz' assertion that O. d. subsp. howellii is indeed a perennial. Still continued work on the longevity of the subspecies would further clarify this matter.

The Antioch Dunes evening-primrose is vespertine; the flowers open in early evening and close by mid-morning. In the garden, the plant flowers from "March to May and briefly in September" (Roof 1969). This Oenothera is

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self-incompatible (Klein 1970) and thus requires cross-pollination for sound seed. Numerous smooth buff- to black-colored seeds are produced in the capsule (Klein 1970). Arnold (pers. comm. 1982) believes that bees are the primary pollinating agent at Antioch. Although hawk-moths were not known on the dunes until 1983, they have been reported as pollinators of other Oenothera species (Gregory 1963). Their role as pollinators of the Antioch Dunes evening-primrose has not been documented. Studies are needed to determine the phenology, pollinators, and seed dispersal mechanisms of this subspecies.

In cultivation, seedlings of the evening-primrose develop vigorously the first spring to a foot or more in diameter (Roof 1969). Although the plant may bloom the first year, it blooms more profusely the second year. The plants grow to approximately three feet in diameter by the second year (Roof 1969) and can reach nearly 3 feet in height (Jim Bartel pers. obs. 1982). After producing an abundance of seed capsules, most of the plants grown in cultivation die off during their second winter (Roof 1969). To reiterate, however, the subspecies is best regarded as a perennial, albeit probably short-lived.

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The Oenothera prefers to grow in nearly pure sand (Roof, 1969) and should be regarded as a psammophyte. Observations of cultivated plants by Roof suggest that seedlings of the Antioch Dunes evening-primrose will not reach maturity where adult plants have recently matured and died. He believed fresh sand was necessary for seedling re-establishment in such areas. Roof noted that seedlings that germinated where adult plants had previously grown perished after attaining a height of approximately 6 inches. He speculated that the evening-primrose exhausted the nutrients within the soil where the preceding generation matured. Roof felt that this was not an unusual phenomenon for psammophytes.

Sandy soils are notorious for their poor nutrient storage capacity. This is because sandy soils not only generally lack the quantity and appropriate kinds of clay particles, but also the organic matter which attracts exchangeable cations. These exchangeable cations, that are the nutrients available to plants, are a function of the cation exchange capacity (CEC) of a given soil (Barbour et al, 1980). Recent work by Pavlik (1979) in the Eureka Dunes in Inyo County confirms that generally sandy dune sub-

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strates have low CEC and, thus, low fertility. Yet, there is no evidence that Oenothera or any other psammophyte reduces further the low fertility of sandy substrates. It seems unlikely that reduced fertility could be a limiting factor for any psammophyte. Other cultural factors of cultivation, like watering regime, planting depth, allelopathy, and disease, might have led or contributed to the death of Roof's succeeding generations of Oenothera seedlings. In addition, his work took place in a different climate with probably a different sand under typical cultural conditions and thus should be viewed in that light.

Pavlik (1979) noted that despite abundant seed production few seedlings of Oenothera avita subsp. eurekensis were seen on the Eureka Dunes. He believes that the germination of psammophytes is dependent on the optimal coincidence of at least three factors: burial, moisture, and critical temperature regime. Arnold's observation, discussed earlier, that the Antioch Dunes evening-primrose produced numerous seedlings in recently disced areas would tend to indicate that the seeds respond favorably to disturbance or burial and not necessarily the deposition

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of nutrient-laden fresh sand as Roof (1969) postulated. Regardless, the data are weak on the population biology of Oenothera deltoides subsp. howellii and further studies are needed for proper management of the dunes and the subspecies.

Threat

In active dune systems undisturbed by man, sand is deposited and redeposited by the wind. The degree to which pristine Antioch Dunes resembled this type of dune system is open to speculation. Considerable evidence exists that indicates that the Antioch Dunes were stabilized in historical times with only limited blowout areas (Alice Howard, pers. comm. 1982). Nevertheless, the invasion of the dunes by exotic vegetation has doubtlessly further stabilized the soil and increased the competition for resources and thus poses a significant problem to those species requiring "fresh" or disturbed sand for survival. To what degree this may affect the reproduction and mortality of the evening-primrose is unknown.

The reduction of habitat within the Antioch Dunes by man may have adversely affected the pollinators of the

D-052708

Oenothera. The self-incompatible evening-primrose (Klein, 1970) is probably pollinated by bees and/or hawkmoths and, therefore, the possibility of reduced fecundity exists. The reduction of habitat (via sand mining, exotic vegetation, and industrial development), however, would seem to be of greater direct consequence to the plants in view of the lack of any data supporting negative impacts to pollinators.

Johnson (1978) reported that almost all of the evening-primrose plants she observed "were infested with (Chrysomelid?) beetles which in attaching to leaves and flower buds reduce reproductive output." Beetles feed on petals, pollen, and seed pods. This factor may need further investigation and is a serious pest (Powell, pers. comm. 1983).

Periodic discing, hiking, and ORV abuse on the dunes have also adversely affected the evening-primrose and its habitat. While only fuelbreak discing remains a threat, the destruction of mature and seedling plants by discing may open up areas for establishment of seedlings. Nevertheless, discing does appear to foster a general "weediness"

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according to Howard (pers. comm. 1982). The affect of discing requires further study and is of great importance. The effect of hikers (primarily fishermen) and illegal ORV enthusiasts has been noticeable. Additional actions will be reguired to deal with these threats.

CONTRA COSTA WALLFLOWER (Erysimum capitatum var. angustatum), a member of the Brassicaceae or mustard family, was originally described as Cheiranthus angustatus by E.L. Greene in 1896 based on specimens collected from "the banks of the San Joaquin River in the interior of California." In 1936, Jepson first placed this wallflower with Erysimum and George Rossbach (1958) later changed the scientific name to Erysimum capitatum var. angustatum. Robert Price, a student at U.S. Berkeley currently preparing a biosystematic revision of the genus Erysimum, does not anticipate any taxonomic changes with the Contra Costa wallflower (Alice Howard, pers. comm. 1982).

The staff of the Regional Parks Botanic Garden under the direction of Roof conducted some autecological studies using cultivated plants of the wallflower. Johnson surveyed a portion of the Antioch Dunes population in 1978.

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Moreover, Arnold has monitored the wallflower in the course of his detailed studies of the Lange's metalmark butterfly. Nevertheless, little work has been completed on the Contra Costa wallflower, especially when compared to that of the other two endangered species found in Antioch Dunes.

Status and Distribution

The Contra Costa wallflower was listed as an endangered species by the U.S. Fish and Wildlife Service on April 26, 1978 (43 FR 17910-17916), while critical habitat (Figure 2) was determined on August 31, 1978 (43 FR 39042-39044).

The Contra Costa wallflower is endemic to the same dune system as Oenothera deltoides subsp. howellii. Populations of this plant are not known to exist in the native habitat outside the Antioch Dunes. The same anthropogenic factors that have affected the butterfly and evening-primrose also have reduced the suitable habitat for the wallflower to but a few acres. The wallflower reportedly is a biennial (Munz 1959); however, according to Harper (1977), it may best be thought of as a monocarpic perennial. That is, individuals die after setting

D-052711

seed, while remaining rosettes that did not flower later became the reproductive individuals generally the following year. Life history work is needed on the Contra Costa wallflower to resolve the question of its longevity.

Johnson (1978) found a total of 174 fruiting plants and 60 rosettes or seedlings on only a portion (27 acres) of the Antioch Dunes in 1978. Johnson's data evidently prognosticated a population decrease for 1979. This did not occur perhaps because she did not adequately census the population. Price (pers. comm. 1982) estimates that at least 700 flowering individuals grow on the dunes. Additional census data are available from Arnold (Howard, pers.comm. 1983). Certainly standardized censusing and monitoring techniques are needed to determine the status of the Contra Costa wallflower.

The wallflower planted within the Tilden Regional Park Botanic Garden was at last report thriving (Roof, pers. comm. 1981). The plant had nearly become a "weed" in cultivation, a character it apparently does not exhibit on the dunes. Roof (1969) felt the wallflower was the most adaptable to garden conditions of all the wallflowers he had cultivated.

D-052712

The wallflower evidently does not require a periodic refreshment of sand in cultivation reported as necessary for the establishment of evening-primrose seedlings (Roof 1969). Wallflower seedlings have "moved" from the sandy bed to several black soil or gravelly locations within the garden, indicating that, at least under garden conditions, the plant does not require sandy soil. The edaphic factors necessary for establishment of Erysimum capitatum var. angustatum, however, are largely unknown and require further study.

Rossbach (1958) believed this variety was restricted to stablize dunes of fine sand with some clay at Antioch. He said the habitat was covered "with sparse herbs and shrubs, or less often with pasture grasses, herbs, and scattered" live oaks (Quercus agrifolia). Johnson (1978) suggested that reproducing individuals occurred principally on uneven sites (e.g., riverfronting cliff faces and edges). One of the more vigorous stands of wallflower was found in an excavated area within the dunes on the McCullough property. The wallflower was believed by Johnson to prefer areas neighboring the river bluffs. Price (pers. comm. 1982), however, recently discovered a

D-052713

large colony adjacent to a fence quite a distance from the river. The plant also grows inland on the McCullough property amidst scrap metal and concrete rubble. Nonetheless, the wallflower appears to be more restricted within the dunes than the evening-primrose.

Fish and Wildlife Service botanists have observed the wallflower growing in steep areas of unstable sand. These slopes generally are not as densely vegetated, which may enable the wallflower to compete better for nutrients and water. However, the wallflower grew at one time on flat terrain on the McCullough property.

Autecological and reproductive biology (life history) studies are needed to further define the biological requirements necessary for the recovery and conservation of the Erysimum. Biosystematic work now under way should assist in this as well as better define the phylogenetic position of the plant within this large genus. However, to reiterate, few data exist on the wallflower when compared to the butterfly and evening-primrose, and thus greater work along these lines will be necessary for the Erysimum.

Threats

The invasion of weedy exotics into disturbed and more open habitats on the dunes may reduce the areas that the Contra Costa wallflower might otherwise colonize. This may still be a significant factor contributing to its decline, but the primary threat in its reduced numbers is the historical loss of habitat through various human activities. Although wildfire may have affected the wallflower, this remains undocumented. Periodic discing for fuelbreak maintenance has destroyed some evening-primrose plants and butterfly habitat, but it has apparently not affected the wallflower. Loss of pollinators and predators may be significant factors affecting reproduction; however, there are no studies or data to support this contention either. Hiking principally by fisherman affects the wallflower, but this threat with proper management can be ameliorated. Detailed autecological studies may reveal the significant factors affecting the wallflower and, therefore, detail the appropriate management course insofar as Erysimum capitatum var. angustatum is concerned.

D-052715

PART II. RECOVERY

Objective

The prime objective of this recovery plan is to prevent the further loss of the Lange's metalmark butterfly, Contra Costa wallflower, and Antioch Dunes evening-primrose; to protect introduced populations and their habitats; and to determine the number of populations which are necessary to reclassify each species to threatened and to delist.

The recovery plan will address the two introduced populations (Brannan and Brown's Islands) of the evening-primrose as well as those on Antioch Dunes. Protecting the remaining habitat from adverse human impact, which has been substantial, is of the greatest importance. These past deleterious activities have included sand mining, fuelbreak maintenance, recreation, agricultural conversion, and industrial developments. Fuelbreak maintenance, recreation, and exotic vegetation perhaps remain the greatest threats for the three species on dunes. Without implementation of this plan, especially habitat protection and management, extinction of these species is expected.

D-052716

Plan Outline

Objective: To prevent the further loss of habitat at Antioch Dunes for the Lange's metalmark butterfly (LMB), Antioch Dunes evening-primrose (ADEP), and Contra Costa wallflower (CCW); to protect introduced populations of each species and their habitats; and to determine the number of populations which are necessary for reclassifying each species.

1. Protect Antioch Dunes ecosystem and essential habitat for LMB, CCW, ADEP

    11. Protect Antioch Dunes ecosystem

        111. Develop protective alternatives and actions in a management plan for refuge land and implement

            1111. Protect (acquire and manage) Sardis property

            1112. Protect (acquire and manage) Stamm-Starr property

            1113. Develop management plan for refuge lands

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1114. Implement management plan

112. Develop protective alternatives and actions with private landowners

1121. Develop MOU with PG&E

1122. Develop MOU with Domtar

1123. Develop MOU with McCullough

12. Protect other essential habitat for LMB, CCW, ADEP

121. Develop protective alternatives and actions with landowner

122. Develop MOU with landowner of other essential habitat

123. Identify other essential habitat

2. Restore Antioch Dunes ecosystem, and increase numbers and improve habitat for LMB, CCW, ADEP

21. Increase numbers and improve habitat for LMB

211. Conduct annual census of population and habitat for LMB

212. Conduct captive-breeding for LMB and propagation program

213. Develop and implement a plan for restoring LMB habitat

214. Conduct life-history studies

2141. Determine habitat requirements

2142. Determine population biology of LMB

2143. Determine other needs of LMB

215. Outplant buckwheat seedlings (where appropriate and necessary)

22. Increase numbers and improve habitat for ADEP

221. Conduct annual census of population and monitor habitat of ADEP

222. Propagate and outplant (if necessary)

223. Develop and implement habitat restoration plan

2231. Develop plan for restoration of habitat

2232. Complete life-history studies

22321. Conduct reproductive biology studies

22322. Conduct autecological studies

2233. Implement ADEP habitat restoration plan

23. Increase numbers and restore habitat for CCW

231. Conduct annual census of population and monitor habitat of CCW

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232. Propagate plants and outplant (if necessary)

233. Develop and implement CCW habitat restoration plan

2332. Complete life-history studies

23321. Conduct reproduction history studies

23322. Conduct autecological studies

2333. Implement CCW habitat restoration plan

24. Rebuild the natural dune substrate and topography to the degree feasible

241. Receive COE sandy dredging spoils

242. Negotiate with COE and Port of Stockton for spoils

243. Prepare sites for spoils

244. Survey sites for candidate and listed species which may be affected by spoils and reduce temporary negative effects of spoils on resident native species

245. Monitor progress of site renovation

25. Reduce or eliminate exotic vegetation

251. Remove vineyard

2511. Select best means for vineyard removal

2512. Study various means for vineyard removal

252. Remove other exotic vegetation

2521. Select best means for removing exotic vegetation

2522. Study various means for removing exotic vegetation

3. Initiate information and education program

31. Erect interpretive signs

32. Print and distribute leaflets explaining need for refuge and restoration of dune ecosystem

33. Develop environmental education program

D-052721

Plan Narrative

The prime objective of this recovery plan is to prevent the further loss of habitat at Antioch Dunes and to restore and protect the Antioch Dunes ecosystem to provide additional habitats for the Lange's metalmark butterfly, Contra Costa wallflower, Antioch Dunes evening-primrose. Recovery efforts must not adversely affect other natural components of the dune ecosystem. Criteria for reclassification of the three endangered species to threatened status must be developed as necessary data are collected and analyzed.

The recovery plan focuses on three major management aspects: 1) protection of the Antioch Dunes and essential habitat for the listed species, 2) restoring the Antioch Dunes ecosystem and increasing or improving the populations or habitat of the listed species, and 3) informing and educating the public about Antioch Dunes.

Basic to any recovery of the three endangered Antioch Dunes species is the protection of the remnants of the dunes ecosystem (11) and any other essential habitat that

D-052722

may be identified (12). The essential habitat for the listed species at one time was all privately owned. To protect a portion of this unique and sensitive area, the properties of Sardis (1111) and Stamm-Starr (1112) were acquired (fee title) in 1980 by the U.S. Fish and Wildlife Service. These acquired parcels are now part of the San Francisco Bay NWR Complex. A management plan for these refuge lands is currently being developed which will provide appropriate guidance insofar as endangered species are concerned (1113).

Measures to be addressed in the management plan are directed toward maintaining habitat conditions and securing populations of all three species. Public use of the Federally acquired lands must be controlled to avoid the negative impacts of vehicle traffic, campfires, excessive and/or random foot traffic, and other related deleterious land uses. Access to critical areas must be restricted. In this regard, barriers, fences, and boundary and interpretive signs have already been placed where necessary. These signs will be replaced if they are vandalized. Various fire control techniques will be considered to determine the safest and most compatible methods for

D-052723

reducing fire hazards in the area and creating fuelbreaks. Techniques may include discing certain areas, mowing, hand weeding, establishment of fire-resistant plants, restoration of native vegetation, selective herbicides, and/or prescribed burning. Fuelbreak and fire related activities must be coordinated with the local Riverview Fire District. Similar protective measures should be developed within the management for the private lands.

The Service will continue to pursue cooperative agreements or MOUs with the adjacent private landowners who own portions of the remaining habitat of the Antioch Dunes. These landowners are PG&E (1121), Domtar (1122), and McCullough (1123). It is hoped these landowners will permit the implementation of various protective actions which will be developed in the refuge management plan (112).

The possibility of identifying additional important areas of potential habitats should be pursued (123). For example, Brannan and Brown's Islands should be examined to determine their suitability as essential habitat for the evening-primrose and as potential habitat for the wallflower. Once an area is identified as essential, an MOU

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should be developed with the landowner (122) followed by the development of protective alternatives and actions with the landowner (121).

Restoration of the Antioch Dunes ecosystem is another major recovery task (2). It would entail stabilizing or increasing the present numbers of individuals and improving the habitat of the three endangered taxa. It would also include restoring the dunes to a biological/topographical condition similar to that prior to the advent of industrial developments in the area.

The populations and habitat of Langes' metalmark butterfly will require intensive management efforts (21). Certain aspects of the biology of this butterfly remain unclear. For any management to be successful, the specific habitat requirements, population biology, and certain other needs must be determined (2141, 2142, 2143). The population must be monitored to determine the status of, and response to, recovery efforts (211). A limited program of captive-breeding of the butterfly (212) and propagating and outplanting of its larval food plant (215) may be necessary if it is determined by analysis of popu-

D-052725

lation/habitat surveys and other specific research that by so doing the species may become self-supporting.

The natural and transplanted populations of the food plant must be protected from destruction or disturbances and from competition with exotics. The studies of the butterfly will assist in the development and implementation of a habitat restoration plan (213).

Recovery of the Antioch Dunes evening-primrose and the Contra Costa wallflower will also require specific management of their populations and habitat (22, 23). Life history studies (2232, 2332), particularly autecological and reproductive biology studies, are needed to determine specific requirements of these species (22321, 22322, 23321, 23322) to develop plants to restore their habitat (2231, 2331). Existing populations will be monitored annually to determine their response to various recovery efforts (221, 231). As necessary, a propagation program will be initiated to supplement recovery of natural populations (222, 232). Both natural and propagated populations must be protected from disturbance or destruction.

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Fuelbreak and fire management practices and other facets of refuge management, such as the continual problem of removal of refuse and garbage, will be implemented within the framework of a habitat restoration plan (223, 233).

Sand mining has devastated large sections of the dunes. Importation of sand to restore the area to historical conditions will be required for the most satisfactory re-establishment of the native biota (24). Plans to prepare previously quarried areas for receipt of dredging spoils or other appropriate sands should be developed in a way that minimizes possible adverse effects on the native biota (244). This will require surveys for present occurrence of biota and coordination with the Corps of Engineers and Port of Stockton (242) before the sites are prepared (243) for receipt of sand (241). The program will require monitoring (245) to prevent accumulation of sand beyond what is considered appropriate for the area or the species of concern.

Restoration of the dunes will also require the reduction or elimination of exotic vegetation (e.g., Ailanthus, Robinia). Removal of exotics (252) will be by the best

D-052727

means available (2521) and developed after careful study of various methods (2522). Similar methodological studies (2512) will involve the removal of the vineyard. Ultimately the most prudent method to remove all or part of the vineyard should be implemented (2511).

The Antioch Dunes are on the fringe of metropolitan San Francisco Bay Area, an area supporting 5 million people. Minimizing the potentially deleterious effects of uncontrolled human use of this fragile habitat will require an effective public relations and education program. Interpretive signs, therefore, should be strategically placed around and within the dunes (31). Information pamphlets explaining the need for the refuge and what activities are necessary to fulfill that need should be written and made available to the public (32). Environmental education programs by refuge personnel to gain public and local governmental support for the recovery effort will aid in preventing conflicts between the human use of the area and the viability of the dunes system (33).

D-052728

Literature Cited

Anonymous. 1971. Antioch primrose sown out of range. Four Seasons 4(1):21.

Arnold, R.A. 1978. Status of six endangered California butterflies. 1977. California Department of Fish and Game. Final Rep. Study V, Job 2.20, 95 pp.

_____. 1980. Ecological studies of six endangered butterflies (Lepidoptera: Lycaenieae); island biography, patch-dynamics, and design of habitat preserves. Ph.D. Dissertation, U.C. Berkeley 363 pp.

Barbour, M.G., J.H. Burk, and W.D. Pitts. 1980. Terrestrial plant ecology. Benjamin/Cummings Publ. Co., Inc. Menlo Park, Calif.

City of Antioch. 1976. Project proposal and environmental assessment - Sand Dunes Waterfront Park. 10 pp.

Greene, E.L. 1976. Studies in the Cruciferae. Pittonia 3:117-138.

Gregory, D.P. 1963. Hawkmoth pollination in the genus Oenothera. Aliso 5:357-384.

Harper, J.L. 1977. Population biology of plants. Academic Press, San Francisco.

Howard, A.Q., and R.A. Arnold. 1980. The Antioch Dunes - Safe at last? Fremontia 8:3-12.

Jepson, W.L. 1925. A manual of flowering plants of California. University of California Press, Berkeley and Los Angeles.

_____. 1936. A Flora of California. II:589. University of California Press, Berkeley.

Johnson, A.F. 1978. Report on Antioch Dunes threatened plant species. California Dept. of Fish and Game, Sacramento. Unpublished paper.

Klein, W.M. 1962. New taxa and recombinations in Oenothera (Anogra). Aliso 5:179-180.

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Klein, W.M. 1970. The evolution of three diploid species of Oenothera subgenus Anogra (Onagraceae). Evolution 24:578-579.

Munz, P.A. 1931. Studies in Onagraceae VI. The subgenus Anogra of the genus Oenothera. Amer. J. Bot. 18:314.

_____. 1959. A California flora. University of California Press, Berkeley and Los Angeles.

_____. 1965. Onagraceae. N.Am. Fl. Series II:5.1-278.

_____. 1968. Supplement to A California flora. University of California Press, Berkeley and Los Angeles.

Pavlik, B.M. 1979. The biology of endemic psammophytes, Eureka Valley, California, and its relation to off-road vehicle impact. Unpublished BLM report - contract no. CA-060-CT8-000049. 110 pp.

Powell, J.A. and R.A. Arnold. 1977. Status of certain insect and plant survivors of the Antioch Dunes. Unpublished paper, 7 pp.

Roof, J.B. 1969. In memoriam: The Antioch Dunes. Four Seasons 3(1):2-4.

Rossbach, G.B. 1958. New taxa and new combinations in the genus Erysimum in North America. Aliso $:115-124.

U.S. Fish and Wildlife Service. 1978. Sensitive Wildlife Information System - Lange's metalmark butterfly. Washington, D.C.

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PART III. IMPLEMENTATION SCHEDULE

The schedule which follows is a summary of actions and costs for the Antioch Dunes Recovery Plan. It is a guide to meet the objectives of the Recovery Plan, as elaborated upon in Part II, Plan Narrative section. This table indictes the general category for implementation, recovery plan tasks, correspondidng action outline number, task priority, duration of the tasks, which agencies are responsible to perform the tasks, and the estimated costs to perform the tasks. Implementing Part III is the action of the recovery plan, that when accomplished, will bring about the recovery of these endangered species. The schedule is subject to revision and update as tasks are completed and/or new tasks are determined necessary.

D-052733

GENERAL CATEGORIES FOR IMPLEMENTATION SCHEDULES

Information Gathering - I or R(research)

1. Population status
2. Habitat status
3. Habitat requirements
4. Management techniques
5. Taxonomic studies
6. Demographic studies
7. Propagation
8. Migration
9. Predation
10. Competition
11. Disease
12. Environmental contaminant
13. Reintroduction
14. Other information

Other

1. Information and education
2. Law enforcement
3. Regulations
4. Administration

Acquisition - A

1. Lease
2. Easement
3. Management agreement
4. Exchange
5. Withdrawal
6. Fee title
7. Other

Management - M

1. Propagation
2. Reintroduction
3. Habitat maintenance and manipulation
4. Predator and competitor control
5. Depredation control
6. Disease control
7. Other management

Task Priority

Priority 1. An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.

Priority 2. An action that must be taken to prevent a significant decline in species population/habitat quality, or some other significant negative impact short of extinction.

Priority 3. All other actions necessary to provide for full recovery of the species.

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PART III

IMPLEMENTATION SCHEDULE

GENERAL CATEGORY	PLAN TASK	TASK NO.	PRIORITY NO.	TASK DURATION	RESPONSIBLE/AGENCY FWS REGION	FWS PROGRAM	OTHER	FISCAL YEAR COSTS $1,000's FY'84	FY'85 (EST.)	FY'86 (EST.)	COMMENTS/NOTES
Protect Antioch Dunes Ecosystem											
A 6	Acquire Sardis property	1111	1		1	Realty*		Completed			Purchases completed in FY'80, $2.2 million
A 6	Acquire Stamm-Starr property	1112	1			Realty*		Completed			Purchase completed in FY'80 within above acquisition
A 4	Develop Management Plan	1113	1	Ongoing	1	Refuges*		2			FY'82, '83 PA Obj. 06, 5c(2)b
M 7	Manage refuge lands	1114	1	Ongoing	1	Refuges*		10	10	10	Ongoing AWR PA Obj.
A 3	PG&E MOU	1121	2	1 year	1	SE*		1			
A 3	Domtar MOU	1122	2	1 year	1	SE*		1			
A 3	McCullough MOU	1123	2	1 year	1	SE*		1			
Protect Other Essential Habitat											
M 7	Develop with other owners habitat management plan	121	2	Continuing	1	SE	CDFG*	TO BE DETERMINED	1	1	
A 3	Other essential habitat MOU	122	2	2 years	1	SE	CDFG*	TO BE DETERMINED	0.25	0.25	

PART III

IMPLEMENTATION SCHEDULE

GENERAL CATEGORY	PLAN TASK	TASK NO.	PRIORITY NO.	TASK DURATION	RESPONSIBLE/AGENCY FWS REGION	FWS PROGRAM	OTHER	FISCAL YEAR COSTS $1,000's FY'84	FY'85 (EST.)	FY'86 (EST.)	COMMENTS/NOTES
R 14	Identify other essential habitats	123	2	2 years	1	SE	CDFG*	TO BE DETERMINED	0.25	0.25	
Restore Antioch Dunes Ecosystem											
R 1	Annual census of LMB	211	2	Continuing	1	Refuges	CDFG*	1	1	1	
M 1	Captive breeding of LMB	212	1	Ongoing	1	SE*					FY'82 PA Obj.5d(9). Project was postponed due to higher recovery needs
M 3	Develop and implement habitat restoration plan for LMB	213	2	5 years	1	Refuges*			2	2	
R 14	Conduct life history studies of LMB	214	2	3 years	1	SE*		UNKNOWN COST			
M 3	Outplant host plant for LMB	215	1	Continuing	1	Refuges*		1.5	1.5	1.5	
R 1	Annual census of ADEP	221	2	Continuing	1	Refuges*	CDFG	1	1	1	
M 2	Propagate and outplant	222	2	3 years	1	Refuges*					
M 3	Develop habitat restoration plan - ADEP	2231	2	1 year	1	Refuges		2			

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PART III

IMPLEMENTATION SCHEDULE

GENERAL CATEGORY	PLAN TASK	TASK NO.	PRIORITY NO.	TASK DURATION	RESPONSIBLE/AGENCY FWS REGION	RESPONSIBLE/AGENCY FWS PROGRAM	RESPONSIBLE/AGENCY OTHER	FISCAL YEAR COSTS $1,000's FY'84	FY'85	FY'86 (EST.)	COMMENTS/NOTES
R 14	Conduct life history studies of ADEP	2232	2	2 years	1	SE*		UNKNOWN COSTS			
M 3	Implement ADEP habitat restoration plan	2233	2	5 years	1	Refuges			2	2	
R 1	Annual census of CCW	231	2	Continuing	1	Refuges*		1	1	1	
							CDFG	1	1	1	
M 1	Propagate and outplant	232	2	3 years	1	Refuges*			2	2	
M 3	Develop habitat restoration plan - CCW	2331	2	1 year	1	Refuges		2			
R 14	Conduct life history studies of CCW	2332	2	2 years	1	SE*		UNKNOWN COSTS			
M 3	Implement CCW habitat restoration plan	2333	2	5 years	1	Refuges*			2	2	
M 3	Rebuild natural dune topography with dredge spoil sand	24	2	3 years	1	Refuges*		1	1	10	
							PS		UNKNOWN COST		
							COE		UNKNOWN COST		
M 3	Remove exotic vegetation including vineyard	25	2	Ongoing	1	Refuges*			UNKNOWN COST		FY'84-85 PA Obj.5(c)
							CDFG		0.5	0.5	
							CNPS		0.5	0.5	

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PART III

IMPLEMENTATION SCHEDULE

GENERAL CATEGORY	PLAN TASK	TASK NO.	PRIORITY NO.	TASK DURATION	RESPONSIBLE/AGENCY FWS REGION	RESPONSIBLE/AGENCY FWS PROGRAM	RESPONSIBLE/AGENCY OTHER	FISCAL YEAR COSTS $1,000's FY'84	FY'85	FY'86 (EST.)	COMMENTS/NOTES
Initiate Information and Education Program											
O 1	Interpretive signs	31	2	1 year	1	Refuges*		1			FY'84 PA Obj.5(c)
O 1	Prepare, print and distribute information leaflets	32	2	Continuing	1	Refuges*		2	1	1	
							CNPS	0.5	0.5	0.5	
							CDFG	0.5	0.5	0.5	
O 1	Develop EE Program	33	2	1 year	1	Refuges*		1			

* - Lead Agency
CDFG - California Department of Fish and Game
CNPS - California Native Plant Society
SE - Endangered Species
PS - Port of Stockton
COE - Corps of Engineers
UCB - University of California, Berkeley

Ongoing - Currently being implemented
Continuing - Ongoing once the task is initially implemented

APPENDIX 1

Partial List of Unique Flora and Fauna of the Antioch Dunes

Endangered Species

Oenothera deltoides subsp. *howellii* (Antioch Dunes evening-primrose)

Erysimum capitatum var. *angustatum* (Contra Costa wallflower)

Apodemia mormo langei (Lange's metalmark butterfly)

Proposed Endangered Species, withdrawn Federal Register, November 1979

Lilaeopsis masonii (Mason's lilaeopsis)

Aster chilensis var. *lentus* (Suisun aster)

Lathyrus jepsonii subsp. *jepsonii* (Delta tule-pea)

Insect Species of Interest

Assumed extirpated from Antioch Dunes, their type locality:

Neduba extincta

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Anthicus antiochensis (Antioch authicid beetle)

Philanthus nasalis (Antioch sphecid wasp)

Perdita hirticeps luteocincta (yellow-banded andrenid bee)

The following are of uncertain status because they are in taxa not adequately surveyed and/or studied in recent years:

Idiostatus middlekauffi (Middlekauff's katydid)

Dysticheus rotundicollis (Antioch weevil)

Colletes turgiventris

The eighth endemic is the Lange's Metalmark butterfly, Apodemia mormo langei, which persists in annually diminishing numbers. Nine of the 19 other insects first described from Antioch are known only from similar sandy habitats in the Central Valley, many of which have been destroyed.

Type locality for 27 insect taxa described thus far - 13 of which are endemic.

Microdynerus (=Leptochilus) arenicolus (Antioch vespid wasp) 1, 4

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Evylaeus sp. nov. (Antioch evening-primrose sweat bee) 1

Perdita scitula antiochensis (Antioch andrenid bee) 1, 4

Idiostatus middlekauffi (Middlekauffs katydid)2, 4

Myrmusula pacifica (Antioch tiphiid wasp) 2, 4

Dysticheus rotundicollis (Antioch weevil) 3, 4

(Type locality may be Merced)

Cophura hurdi (Antioch robberfly) 3, 4

Philanthus nasalis (Antioch sphecid wasp) 3, 4

Perdita hirticeps lenteocincta (Yellow-banded ardrenid bee) 3, 4

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1 - Extant at Antioch Dunes
2 - Possibly extant at Antioch Dunes
3 - Presumed extinct
4 - Notice of Review (Federal Register, May 1980)

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Reptile Species of Interest (northermost range extensions)

Arizona elegans (glossy snake)

Uta stansburiana hesperis (side-blotched lizard)

Anniella nigra (legless lizard)

Other Plant Species of Interest

Undescribed subspecies of Lupinus albifrons

Eriogonum nudum var. auriculatum (host plant for Apodemia mormo langei)

Rare Insects Found at Antioch or Antioch and a Few Other Arid Areas

Neuroptera	Brachynemurus infuscatuus	N.C.N.
Diptera	Efferia antiochi	N.C.N.
Diptera	Metapogon hurdi	N.C.N.
Hymenoptera	Eucerceris ruficeps	Antioch sand wasp
Hymenoptera	Melissodes hurdi	N.C.N.
Hymenoptera	Perdita ciliata	N.C.N.

D-052742

APPENDIX 2

STATUS SUMMARY OF NINE ANTIOCH DUNES INSECTS

by

Larry L. Eng, Ph.D.
August 1980

Very little information is available on the nine Antioch Dunes insects presently under status review by the U.S. Fish and Wildlife Service. The following information was obtained by reviewing our file material and contacting entomologists at the Univesity of California campuses at Berkeley and Davis. Two of the species are still extant, two are possibly extant, and five are presumed extinct. Our limited information is summarized below by species.

Antioch Vespid Wasp (Leptochilus arenicolus)

This species still exists at Antioch Dunes. R.M. Bohart, who described the species from specimens collected at Antioch, points out that the genus has been revised and the scientific name is accurately Microdynerus arenicolus (Bohart). Dr. Bohart also reports that while the preponderance of material in the University of California, Davis insect collection is from Antioch, they have one lot taken in 1916 labeled Auburn.

D-052743

Antioch Andrenid Bee (Perdita scitula antiochensis)
This bee was common at Antioch Dunes, where it is endemic, during an intensive survey in 1976-77 of the sand dwelling insects by J.A. Powell and associates from the University of California, Berkeley.

Middlekauff's Katydid (Idiostatus middlekauffi)
Another Antioch endemic, this species has not been collected since 1965. Since recent studies on the dunes have emphasized diurnal collecting, and since this katydid may be crepuscular, it may still be present. This possibility should be investigated.

Antioch Weevil (Disticheus rotundicollis)
This weevil has apparently not been collected since 1952 and is presumed extinct.

Valley Mydas Fly (Raphiomydas trochilus)
This large fly has not been collected at Antioch since 1974. A good colony was present at the dunes during the 1950's. It is presumed extinct, but since R. trochilus was described from specimens collected at Merced, it might still exist elsewhere in the San Joaquin Valley if suitable sand habitat still remains.

D-052744

Antioch Robber Fly (Cophura hurdi)

This species is apparently known only from the type specimen collected in 1939 and subsequently lost.

Antioch Sphecid Wasp (Philanthus nosalis)

This Antioch Dunes endemic apparently was last collected in 1959 and is presumed extinct.

Yellow-banded Andrenid Bee (Perdita hirticeps leuteocincia)

Also an Antioch Dunes endemic, this subspecies has not been collected since 1939 and is presumed extinct.

Faunistically, the Antioch Dunes has many affinities with the Mojave Desert. Many desert species reach their northern limits here. Others, while showing relationships to southern species have evolved into distinct species and/or subspecies. Presumably the Antioch Dunes was isolated during prehistoric times from a biogeographic element which extended north along the western edge of the Central Valley (Powell and Arnold 1977). As a result of the long period of isolation and diverse microhabitats, the Antioch Dunes has a high degree of endemism.

D-052745

The dune habitat was dramatically reduced during the 1950's by sand mining and industrial development of the area. The decline and/or disappearance of several species coincided with this industrial development. Development and sand mining have continued until the recent purchase by the U.S. Fish and Wildlife Service of most of the very little dune habitat that remains. Because of the extensive loss of habitat and the invasion of the area by weedy annual plants, even with the protection provided to federal ownership and management, any species which is endemic to the Antioch Dunes must be considered endangered. The Antioch Dunes is a mozaic of microhabitats and these microhabitats are necessary to maintain its high species diversity. While it is important to recognize all components of the biological community at Antioch, it is imperative that all endemic species and their microhabitats be identified before any manipulation to improve or restore the habitat for listed species be initiated. Because, realistically, listed species are given priority in management it is important to list all endemics within an area so that they are not unintentionally extirpated through oversight in managing the habitat for other endangered species.

FWS Footnote

Preceding is subject to revision/amendment by Dr. Eng or others. The information is included here only to indicate what was known generally at the time (August, 1980).

D-052747

APPENDIX 3

LIST OF AGENCIES/INDIVIDUALS COMMENTING

FEDERAL AGENCIES

U.S. Fish and Wildlife Service - Washington, D.C. and Portland, OR

Heritage Conservation and Recreation Service - San Francisco, CA

Department of the Army, Corps of Engineers - Sacramento and San Francisco, CA

STATE AGENCIES

California Department of Fish and Game - Sacramento, CA

COUNTY AGENCIES

Contra Costa Planning Department - Martinez, CA

MUNICIPALITIES

City of Antioch, CA

COMMERCIAL

Pacific Gas and Electric Company - San Ramon, CA

CONSERVATION ORGANIZATIONS

Lepidoptera Specialist Group, IUCN - Gray's River, WA

INDIVIDUALS

Richard Arnold, University of California - Berkeley, CA

Annetta Carter - Albany, CA

Charlice W. Danielsen - Kensington, CA

Lavina Falconer - El Cerrito, CA

Stanley J. Farwig - Concord, CA

Ruth and Stephen Fiske - Berkeley, CA

Jenny and Scott Fleming - Berkeley, CA

August Fruge - Berkeley, CA

Neil Havlik - Albany, CA

Lawrence R. Heckard - Berkeley, CA

Alice Q. Howard - Oakland, CA

Walter Knight, East Bay Regional Park District - Oakland, CA

Senator J.A. Nejedly (Office) - Contra Costa, CA

Roger Reeve - Oakland, CA

Erwin Scrohmaier - Berkeley, CA